GFD®
FROM PSL

USER'S MANUAL

OPERATION AND MAINTENANCE

PF-00003-230
PF-00003-115

psl

www.powdersystems.com

USER'S MANUAL

OPERATION AND MAINTENANCE GUIDE

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Other languages of this documentation can be found at:

www.sigma-aldrich.com/glass-filter-dryers

1.0 PREFACE

Dear CUSTOMER

WELCOME TO THE GFD®

A simpler approach to lab scale filtration and drying!

The GFD® is an innovative laboratory solution filling a need in today's R&D labs, whether in the chemical or pharmaceutical industry. Indeed, this replacement technology combines within one piece of equipment, existing filtration and drying methods and therefore actually supersedes Buchner filtrations and Tray drying.

Established since 1989 in the pharmaceutical industry as a pioneer in containment and filtration technologies (production scale) PSL have used our world class experience to offer a better approach to Lab scale filtration and drying to the world of chemistry **» The GFD®.**

This equipment is available in 3 sizes thus suiting the needs of small labs to kilo-labs, a product line designed to give the opportunity to perform the best **scale-up studies** in the global market today.

Combining filtration and drying within one piece of equipment is the guarantee that liquid and solid separation process development benefit from**:**

»Minimum Process Disruption »Batch Homogeneity »Improved Yield

»Reduced Product Exposure »Process visibility

Contrary to other larger sizes ANFD's the GFD® has a unique feature, the **Removable Filter Basket.** This patent pending feature is an innovation in the industry and offers unique product handling experience. It guarantees:

»Full Product Recovery »Easy Cleaning »Improved Yield

Today, the GFD® is a laboratory process equipment meeting all the requirements of the global industry.

Most of the liquid/solid separation requirements can be applied in this new apparatus which makes the GFD® a truly global solution that fits in every lab.

We hope you will greatly benefit from your purchase and whish you to enjoy the GFD® Experience.

2.0 INTRODUCTION

BEFORE USING THE GFD®, PLEASE READ THE FULL MANUAL.

The GFD® User's Manual has been designed to provide general guideline to safely set-up, handle and operate the equipment.

As a process equipment the user's requirements will determine how to use the GFD®, however, you will find in this manual information on what cannot be done and what could be done.

"Section 3: Product Summary" displays all the technical core data of the GFD® such as specifications including all spares and options and the general arrangement drawing.

"Section 4: General Safety" lists all the principal safety aspects to consider before, while and after using the GFD®. This section is to be read before handling, setting-up and operating the GFD®.

"Section 5: Unpacking & Assembling the GFD®" is a duplicate of the QUICK START manual included in the GFD® Packaging and explains how to unpack the GFD® in a safe manner.

"Section 6: Mechanical Operations Guide" deals with the set-up and handling of the GFD®. You will discover how to use main components and perform basic mechanical actions on the GFD®. We also give an example of how a GFD® can be set-up in line with a reactor.

"Section 7: Process Operations Guide" is a guide to use the GFD® with products. Each user will dry and filtrate different products with different process requirements and this section can only describe certain ways to operate the GFD® in a process that may not be applicable in certain cases.

"Section 8: Maintenance" gives guideline to maintain the GFD® in order to guarantee its longevity and the quality of its performances.

"Section 9: PSL Quality Certificates" contains the Declaration of Engineering and the certificate of conformity.

"Section 10: Annex 1"

3.0 PRODUCT SUMMARY

3.1 Product Code

PRODUCT CODE	VOLTAGE	PLUG CONNECTION
PF-00003-230	230v - 50 HZ	**UK**: Type G, BS 1363 – (13A/230-240V 50Hz grounded and fused). **Europe**: Type E/F Hybrid CEE 7/7 (16A/250V grounded).
PF-00003-115	115V - 60HZ	**US**: NEMA 5-15 (15A/125V grounded). **Japan**: JIS C 8303, Class I (15A/100V grounded)

3.2 General Design Data

Filtration area	0.05m²		
Cake volume	5 Litres		
Cake depth (max)	100mm		
Volume	10 Litres		
	Vessel	**Jacket**	**Unit**
Design temperature (Min)	- 25 (-13)	- 25 (-13)	ºC (ºF)
Design temperature (Max)	150 (302)	150 (302)	ºC (ºF)
Design Pressure (Min)	Full Vacuum	Full Vacuum	barg (psig)
Design temperature (Max)	0.5 (7.25)	0.5 (7.25)	barg (psig)
Area Classification Internal/External	Safe Area		
OEL	The PSL GFD® is not classified as containment equipment and therefore has to be used in conjunction with other equipment suitable to protect operator from exposure to potent compounds.		

3.3 Mechanical Data

Product contact materials	Product contact areas will be Borosilicate 3.3 Glass, PTFE coated stainless steel, polypropylene, Silicone, Viton unless otherwise stated.
Non Product contact materials	304L Stainless steel, Powder coated mild steel. Some minor proprietary procured items such as pipe clips may only be available in lower stainless steel grades. Some proprietary procured items, will be provided in the manufacturers' standard materials.
Vessel/basket clamping	304L Stainless steel quick release clamp. PTFE lined.
Filter basket	Polypropylene filtration basket. Filter cloth is welded to the base of the basket.
Filtration media	Polypropylene cloth, nominal pore size 20µm.

Basket o-rings	5mm section Silicone White - 60 shore hardness.
Filter basket support	Polypropylene plate with filtration holes.
Heating Jacket	The base jacket is constructed in Borosilicate 3.3 Glass. KF15 Flange connections for inlet and return of heating/cooling fluid.
Vessel Support	304L stainless steel, Powder coated mild steel.
Agitator	PTFE blade with 16mm diameter PTFE coated stainless steel shaft.
Agitator seal	PTFE seal rated FV and 0.5 barg (7.25 psig).
Agitator Positioning	Manual rack and pinion agitator/drive raise/lower system in anodised aluminium with glass fibre reinforced polyamide handle. Power assisted lifting stainless steel gas strut.
Speed of rotation	5-26 RPM.
Vessel process stoppers	Rodaviss Polyurethane cap, Borosilicate 3.3 Glass stopper, Viton o-ring seal.

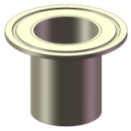
3.4 Electrical Data

Motor	0.18 kW; 100-120V/47-63Hz or 200-240V/47-63Hz, IP55 rated, output torque 60Nm.
Motor Controls	On/Off, Clockwise (Plough), Anti-clockwise (Smooth), Speed adjustment.
Speed indication	Detachable hand held controller with Illuminated, high resolution LCD graphics screen, on/off, clockwise (plough), anti-clockwise (smooth), speed adjustment, switchable torque or RPM display, 1 RPM accuracy.
Plug Connection	UK: Type G, BS 1363 – (13A/230-240V 50Hz grounded and fused). Europe: Type E/F Hybrid CEE 7/7 (16A/250V grounded). USA: NEMA 5-15 (15A/125V grounded). Japan: JIS C 8303, Class I (15A/100V grounded).

3.5 General Arrangement Drawing

Please see Annex 1

3.6 Options

PICTURE	PART No	PART NAME	DESCRIPTION
N/A	***ID00003***	cGMP certification	Documents certifying compliance to FDA regulation 21CFR. Copy of GFD® test document. Certificates of materials of construction.
	IP00111	*Heat Transfer Jacket Connector - Straight*	DN 15 Chrome plated steel with FEP o-ring seal, thread M16 x 1mm Pitch.
	IP00045	*Heat Transfer Jacket Connector - 90deg Elbow*	
	***IM00142***	*Polypropylene Basket, Nominal Pore size: 7 micron*	Polypropylene filtration basket. Filter cloth is welded to the base of the basket.
	IM00143	*Polypropylene Basket, Nominal Pore size: 12 micron*	
	IM00144	*Stainless Steel basket, Nominal Pore size 5 micron*	316L filtration basket. Filter media is welded to the base of the basket.
	IM00145	*Stainless Steel basket, Nominal Pore size: 10 micron*	
	IM00028	*Stainless Steel basket, Nominal Pore size: 20 micron*	
	IM00147	*Alloy 22 basket, Nominal Pore size 5 micron*	Alloy 22 filtration basket. Filter media is welded to the base of the basket.
	IM00148	*Alloy 22 basket, Nominal Pore size: 10 micron*	
	IM00149	*Alloy 22 basket, Nominal Pore size: 20 micron*	
	IM00150	*Agitator Stainless Steel*	316L Stainless steel blade with 316L Stainless Steel Shaft.
	IM00151	*Agitator Alloy 22*	Alloy 22 blade with Alloy 22 Shaft.
	IP00152	*Basket O-ring – Viton*	3mm section Viton – 70/75 Shore hardness.
	IP00153	*Basket O-ring – White perfluoroelastomer*	3mm section Perfluoroelastomer – 70/75 Shore hardness.
	IM00154	*Vacuum Bottle*	10 Litre White Polypropylene bottle and 2 way connectorTPE seal -10...+135 °C, autoclavable.
	IP00056	*Temperature Infra-red probe*	Digital Pyrometer, LCD 4 Digit display, 3 Hz sampling rate, resolution 0.1°C, temp range 30°C to 200°C, Aluminium housing, stainless steel sensor head. Instrument IP20, sensor head IP65. INCLUDED: Rodaviss to GL nozzle adaptor and mains power adaptor.

3.7 Spares

PICTURE	PART No	PART NAME	DESCRIPTION
	MG00010	*Stopper Kit*	Rodaviss Polyurethane cap, Borosilicate 3.3 Glass stopper, Viton o-ring seal. Include complete rodaviss stopper package for lid nozzles.
	IM00033	*PTFE coated Agitator*	PTFE blade with PTFE coated stainless steel shaft.
	MG00007	*Agitator Seal Kit*	PTFE seal rated FV and 0.5 barg (7.25 psig). Complete with rodaviss connector.
	IM00024	*Pressure Clamp*	304L Stainless steel quick release clamp. PTFE lined, powder coated.
	IM00036	*Polypropylene Basket Nominal Pore Size 20µm*	Polypropylene filtration basket. Filter cloth is welded to the base of the basket. Media: 20µm polypropylene cloth.
	IM00035	*Polypropylene Support Plate*	Polypropylene plate with filtration holes.
	IP00058	*Basket O-ring Silicone*	3mm section Silicone White – 60 shore hardness.
	IM00026	*Glass Ware - Vessel Lid*	Maxi Vessel Lid. Borosilicate 3.3 Glass.
	IM00037	*Glass Ware - Vessel Base*	Maxi Vessel Base. Borosilicate 3.3 Glass.
	IP00057	*High Torque Bi-directional Motor 230V*	0.18Kw motor, 200-240V/47-63Hz, IP55 rated. Output torque 68Nm.
	IP00174	*High Torque Bi-directional Motor 115V*	0.18Kw motor, 200-240V/47-63Hz, IP55 rated. Output torque 68Nm.
	IP00112	*RPM and Torque Display Parameter Box*	Detachable hand held controller with illuminated, high resolution LCD graphics screen, on/off, clockwise (plough), anti-clockwise (smooth), speed adjustment, switchable torque or RPM display, 1 RPM accuracy.

4.0 GENERAL SAFETY INSTRUCTIONS

The **GFD®** **MUST ONLY** be operated and maintained by appropriately trained personnel who have read and fully understood the instructions and requirements detailed within this Operating and Maintenance Manual.

IMPORTANT

The maximum pressure permitted within the vessel is 0.5 Barg; **ENSURE** that a suitable relief valve is fitted in the supply line to ensure this pressure cannot be exceeded.

The vessel jacket is rated to 0.5 Barg, however, the jacket **MUST** not be pressurised because it is not designed as a closed system. The heating medium used within the jacket **MUST BE** re-circulating.

NO SAFETY INTERLOCKS ARE PROVIDED ON THIS EQUIPMENT AND IT IS NOT CURRENTLY RATED FOR HAZARDOUS AREA OPERATIONS

IF IN DOUBT – DO NOT PROCEED – PLEASE ASK

SAFETY SYMBOLS

These notes indicate where there are risks of electric shock for the operator.

These notes indicate where there are risks of injury to the operators or possible loss of containment.

These notes indicate where there are risks of damage to the equipment.

These notes indicate useful supplementary information.

4.1 SAFETY INSTRUCTIONS FOR ELECTRICAL DEVICES

Read all the safety advice and instructions! Failure to observe the safety advice and instructions may result in electric shock, fire and / or serious injury.

KEEP ALL THE SAFETY ADVICE AND INSTRUCTIONS IN A SAFE PLACE FOR FUTURE REFERENCE!

4.1.1 Workplace Safety

WARNING

Keep your working area clean and well lit. Untidy or poorly lit working areas can lead to accidents.

WARNING

Do not work with the device in potentially explosive environments in which there are inflammable liquids, gases or dusts. Electrical devices create sparks, which can ignite dusts or fumes.

4.1.2 Electrical Safety

To avoid danger to life from electric shock:

WARNING

DANGER

The mains plug on the device must match the mains socket. The plug must not be modified in any way. Do not use an adapter plug with devices fitted with a protective earth. Unmodified plugs and matching sockets reduce the risk of electric shock.

WARNING

DANGER

The **GFD** ® is made for indoor use only.

WARNING

DANGER

Keep the device away from rain or moisture. Water entering an electrical device increases the risk of electric shock.

WARNING

DANGER

Do not use the mains lead for any purpose for which it was not intended, e.g. to carry the device, to hang up the device or to pull the mains plug out of the mains socket. Keep the mains lead away from heat, oil, sharp edges or moving parts of the device. Damaged or tangled mains leads increase the risk of electric shock.

WARNING

DANGER

Use a residual current device (RCD) for protection if operating the electrical device in a moist environment is unavoidable. The use of an RCD reduces the risk of electric shock.

4.1.3 Personal Safety

WARNING

Remain alert at all times, watch what you are doing and always proceed with caution. Do not use the device if you are tired or under the influence of drugs, alcohol or medication. One moment of carelessness when using the device can lead to serious injury.

WARNING

Wear personal protective equipment and always wear safety glasses. The wearing of personal protective equipment such as dust masks, non-slip safety shoes, safety helmets or ear protectors, appropriate to the type of electrical device used and work undertaken, reduces the risk of injury.

WARNING

Avoid unintentional operation of the device. Check that the mixer is switched off before you connect it to the mains, pick it up or carry it. Accidents can happen if you carry the device with your finger on the **ANTI-CLOCKWISE / OFF / CLOCKWISE** switch or with the device switched on.

WARNING

Remove any setting tools or spanners before you switch the device on. A tool or spanner left attached to a rotating part of a device can lead to injury.

WARNING

Avoid placing your body in an unnatural position. Keep proper footing and balance at all times. By doing this you will be in a better position to control the device in unforeseen circumstances.

WARNING

Wear suitable clothing. Do not wear loose clothing or jewellery. Keep your hair, clothing and gloves clear of moving parts. Loose clothing, jewellery or long hair can become trapped in moving parts.

4.1.4 Careful Handling and Use of Electrical Devices

CAUTION

Do not overload the device. Always use an electrical device that is intended for the task you are undertaking. By using the right electrical device for the job you will work more safely and achieve a better result.

CAUTION

Do not use the mixer if its switch is defective. An electrical device that can no longer be switched on and off is dangerous and must be repaired.

CAUTION

Pull the mains plug out of the socket before you make any adjustments to the device, change accessories or when the device is put away. This precaution is intended to prevent you from unintentionally starting the device.

CAUTION

Look after the device carefully. Check that moving parts are working properly and move freely. Check for any parts that are broken or damaged enough to detrimentally affect the functioning of the device. Have damaged parts repaired before you use the device. Many accidents have their origins in poorly maintained electrical devices.

4.2 OPERATION SAFETY INSTRUCTIONS

WARNING

The Operator should ensure that an appropriate RISK ASSESSMENT has been undertaken for the operation and maintenance of the **GFD®** and that where identified as required, appropriate PPE (Personal Protection Equipment) is worn.

WARNING

The Operator must ensure that where appropriate, suitable Safety Procedures are implemented to protect personnel from potential injury.

WARNING

PRIOR to commencing operations with the **GFD®** it is extremely important that a suitably sized **CLEAR VIEW PERPEX SCREEN** is positioned between the operator and the **GFD®** to protect personnel from potential injury should an unforeseen incident occur involving the glass components of the equipment.

WARNING

Please be aware that both the vessel base and vessel lid of the **GFD®** are of glass construction, it is therefore essential that care is taken when handling these components to avoid both damage to components and the potential risk of injury to personnel.

WARNING

DO NOT over tighten the clamp adjoining the vessel base and vessel lid components as this could damage the glass. The torque required to seal the vessel with the clamp is minimal, once located into position, close the clamp and turn the clamp retaining screw clockwise a few turns until slight friction is felt, this will be sufficient to both retain the clamp in position and seal the vessel.

5.0 UNPACKING & ASSEMBLING THE GFD®

5.1 Unpacking

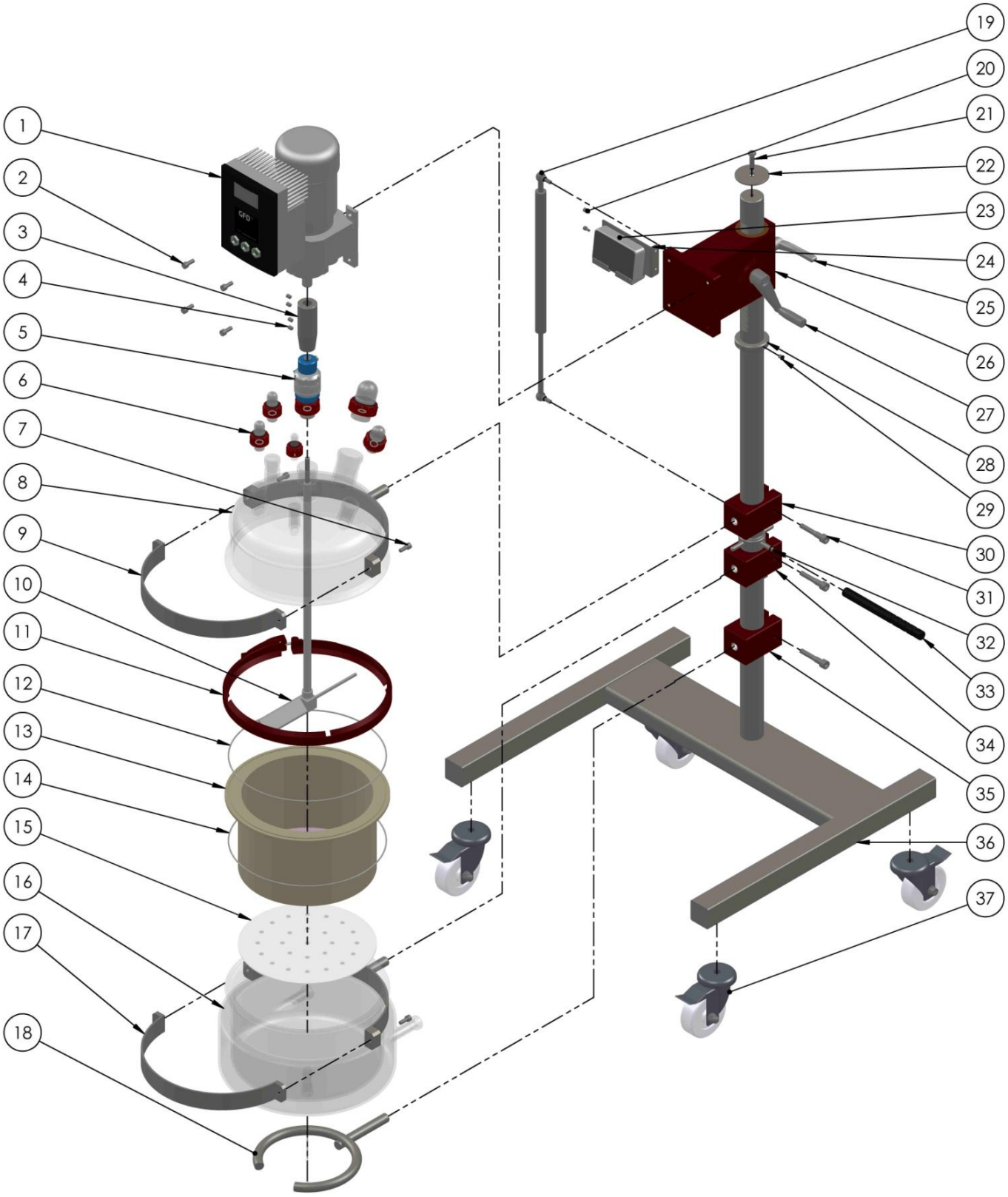
The Maxi GFD should arrive part assembled in its purpose built wooden crate, any parts that still require assembling such as the glass vessel will be separately packed in cardboard boxes, within the crate.

Ensure when unpacking to be careful not to damage any of the fragile parts, particularoy the glass vessel and stoppers.

When unpacked check against the following parts list and assembly drawing that every part is present.

5.2 PARTS

Please refer to the parts list next page:



NO.	NAME	PART NO.	QTY	COMMENTS
1	HIGH TORQUE BIDIRECTIONAL DRIVE UNIT	IP00057/ IP00174	1	Available As Spare
2	DRIVE UNIT MOUNTING SCREW	N/A	4	
3	MOTOR COUPLING	IM00025	1	Already Fitted
4	COUPLING LOCKING SCREW	N/A	4	Already Fitted
5	AGITATOR SEAL KIT	MG00007	1	Available As Spare
6	STOPPER KIT	MG00010	1	Available As Spare, Contains; 2 x 24/29 Stoppers 1 x 19/26 Stopper 1 x 29/32 Stopper 1 x 45/40 Stopper
7	VESSEL SUPPORT CLAMP SCREW	N/A	4	
8	GLASS WARE - VESSEL LID	IM00026	1	Available As Spare
9	VESSEL SUPPORT CLAMP -LID	IM00022	1	Already Fitted, Same As Part 17
10	PTFE COATED AGITATOR	IM00033	1	Available As Spare
11	PRESSURE CLAMP	IM00024	1	Available As Spare
12	O-RING - WHITE SILICONE - BASKET	IP00058	1	Available As Spare, Same As Part 14
13	FILTER BASKET – POLYPROPYLENE, NOMINAL PORE SIZE: 20 µm	IM00036	1	Available As Spare
14	O-RING - WHITE SILICONE - VESSEL	IP00085	1	Available As Spare, Same As Part 12
15	FILTER MESH SUPPORT PLATE	IM00035	1	Available As Spare
16	GLASS WARE - VESSEL BASE	IP00037	1	Available As Spare
17	VESSEL SUPPORT CLAMP -BASE	IM00022	1	Already Fitted, Same As Part 19
18	LOWER VESSEL BASE SUPPORT	IM00038	1	Already Fitted
19	GAS STRUT	IP00060	1	Already Fitted
20	PARAMETER BOX BRACKET SCREW	N/A	2	Already Fitted
21	SUPPORT FRAME CAP SCREW	N/A	1	Already Fitted
22	SUPPORT FRAME CAP WASHER	N/A	1	Already Fitted
23	DRIVE UNIT PARAMETER BOX	IP00112	1	Available As Spare
24	PARAMETER BOX BRACKET	IM00165	1	Already Fitted
25	CLAMPING HANDLE	IP00053	1	Already Fitted
26	RAISE LOWER MECH HOUSING	IM00034	1	Already Fitted
27	CRANK HANDLE	IP00052	1	Already Fitted
28	POSITIONAL STOP	IM00040	1	Already Fitted
29	POSITIONAL STOP LOCKING SCREW	N/A	2	Already Fitted
30	MOUNTING CLAMP – LID SUPPORT	IM00021	1	Already Fitted
31	MOUNTING CLAMP SCREW	N/A	3	Already Fitted
32	SUPPORT FRAME JACKING NUT	N/A	1	Already Fitted

33	LEVER	IM00170	1	
34	MOUNTING CLAMP – BASE SUPPORT	IM00023	1	Already Fitted, Same As Part 35
35	MOUNTING CLAMP – LOWER BASE SUPPORT	IM00023	1	Already Fitted, Same As Part 34
36	SUPPORT FRAME	IM00029	1	Already Fitted
37	BRAKED CASTOR	IP00061	1	Already Fitted

5.3 FIRST TIME ASSEMBLY AND SET-UP

✓ Step 1 – Glass Vessel

- Ensure the drive assembly is raised to its highest position by undoing the Clamping Handle (Item 25) and turning the Crank Handle (Item 27) clockwise **(Figure 1.a)**
- Insert Filter Mesh Support Plate (Item 15), Vessel O-ring (Item 14), Filter Basket (Item 13) & Basket O-ring (Item 12) into Glass Vessel Base (Item 16). Then insert the Glass Vessel Base into position and secure in place by fixing the front of Vessel Support Clamp –Base (Item 17). **(Figure 1.b)**

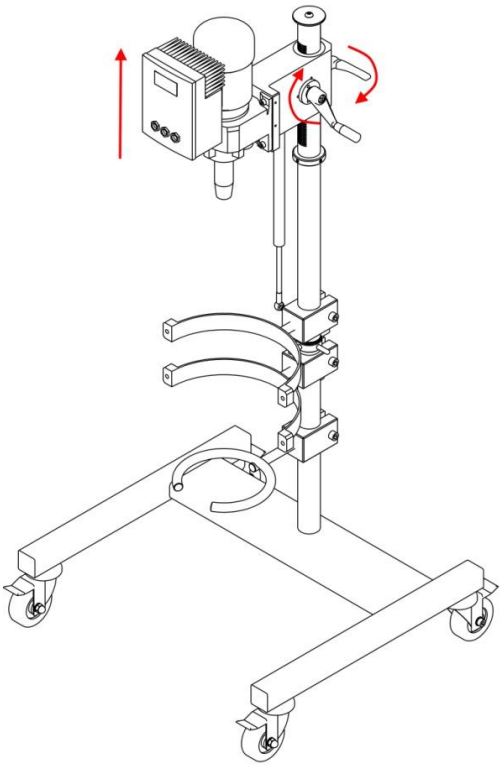


Figure 1.a

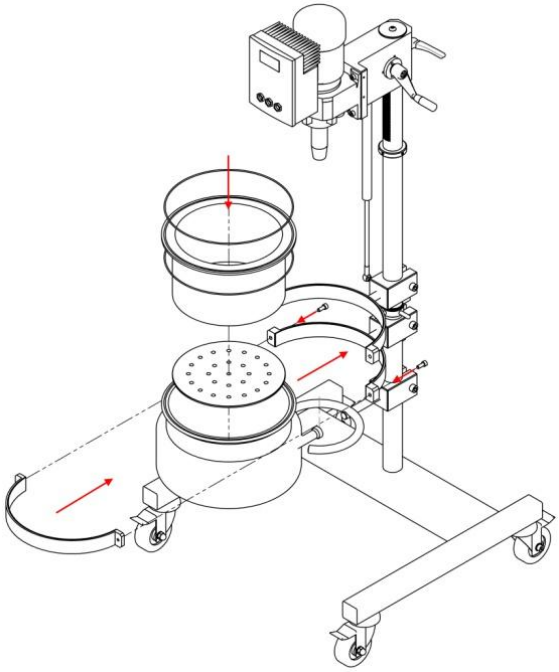


Figure 1.b

- Screw Agitator Seal Kit (Item 5) onto central nozzle on Glass Vessel Lid (Item 8). Then insert the Glass Vessel Lid into position on top of filter basket and concentric with the Glass Vessel Base and secure in place by fixing the front of Vessel Support Clamp –Lid (Item 9) **(Figure 1.c)**

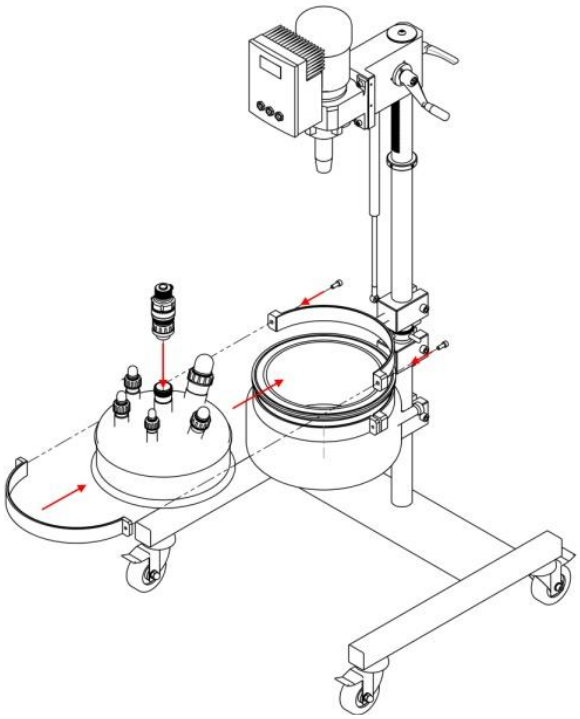


Figure 1.c

✓ Step 2 – Agitator

- Insert Lever (Part 33) onto one of the spokes on Support Frame Jacking Nut (Item 32) and turn clockwise to raise the top half of the support frame, including the Drive assembly and the vessel lid assembly. **(Figure 2.a)**

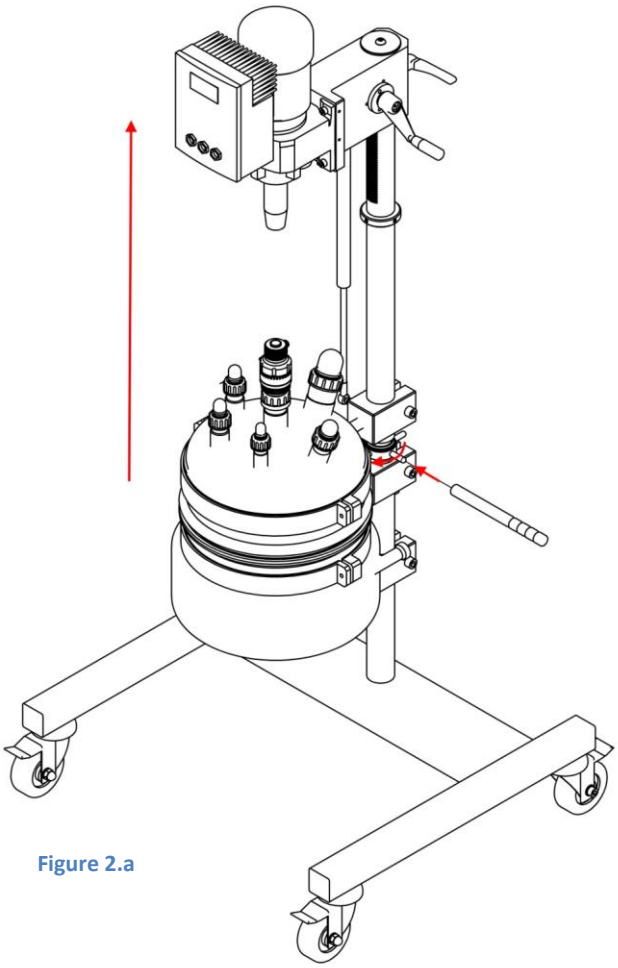


Figure 2.a

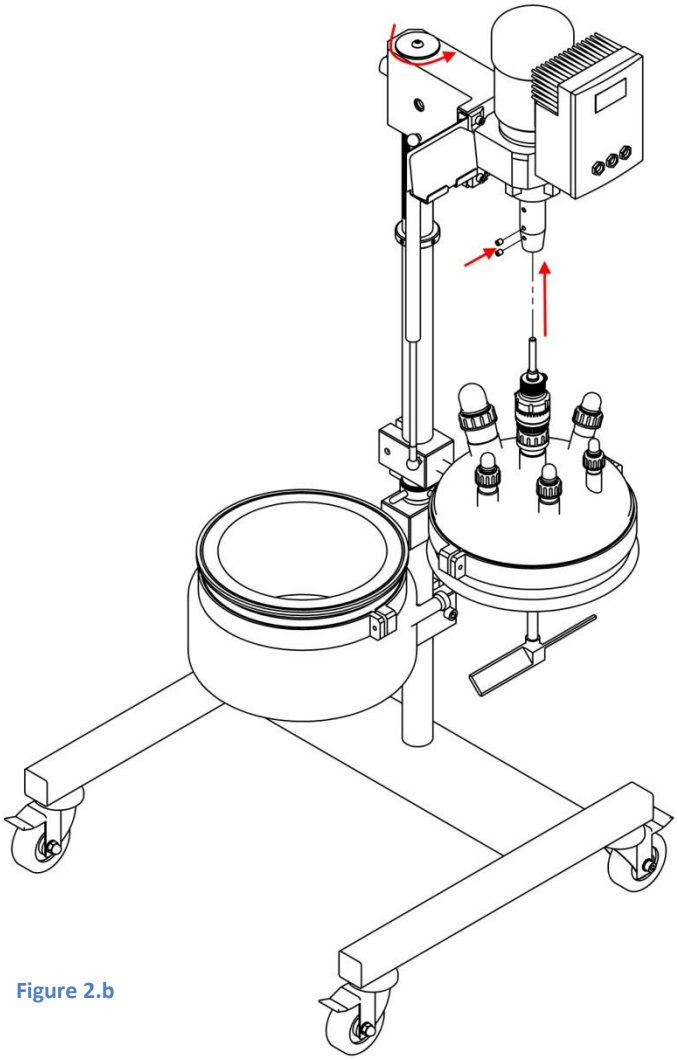


Figure 2.b

- The top of the support frame should now be free to rotate 90degrees to either side. Insert PTFE Coated Agitator (Item 10) through Agitator Seal Kit (Item 5), (See section 6.2.2 for more information on using the Agitator seal.) lock the metallic end of the agitator in to the Motor Coupling (Item 3) using the two Coupling Locking Screws (Item 4) **(Figure 2.b)**
- Rotate the top of the support frame back to the centre and lower by turning the Support Frame Jacking Nut anticlockwise.

6.0 MECHANICAL OPERATIONS GUIDE

The following section explains how to set-up the GFD® and mechanically operate the equipment.

6.1 PRE-CHECKS

The operator must ensure that;

- ✓ all safety requirements and procedures have been implemented
- ✓ the GFD® is appropriately located and stable
- ✓ any service connections (Heating media), (Pressure) to the apparatus are in place and fully operational
- ✓ all seals are in place and properly secured for the vessel to accept product
- ✓ the power supply for the GFD® is of the correct voltage, phase and frequency and is fitted with an RCD or similar safety circuit breaker.

6.2 ADJUSTING THE AGITATOR HEIGHT

6.2.1 Safety

WARNING

Before commencing to loosen the agitator shaft seal and the clamp of the torque mixer to raise the agitator out of the product, it is essential that the system has been vented to ensure that the vessel interior is at atmospheric pressure and is free of any harmful gasses or vapours.

6.2.2 Agitator Seal

The Agitator seal is composed of:

1: Lock Nut. This should be tightened when using the GFD vessel under vacuum or pressure. The Nut must be released to allow vertical adjustment of the agitator.

2: Lock nut retainer (to unscrew in order to be able to unscrew the top screw cap)

3: Upper pin

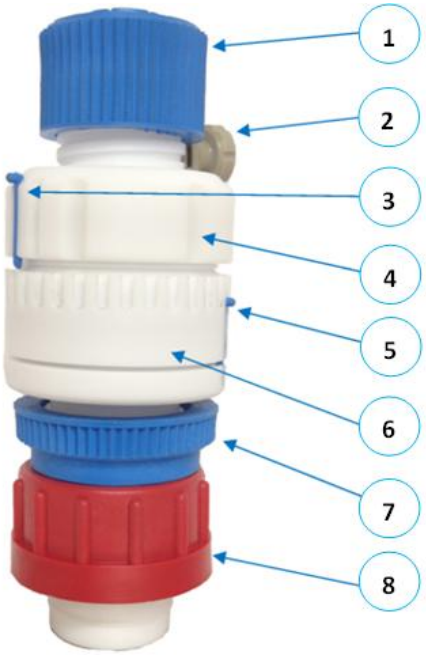
4: Upper body

5: Lower pin

6: Lower body and retaining ring

7: Release nut for removing the red screw cap

8: Screw cap and o-ring that fits onto the central nozzle on the vessel lid



6.2.3 Fitting the Agitator Seal and the Agitator

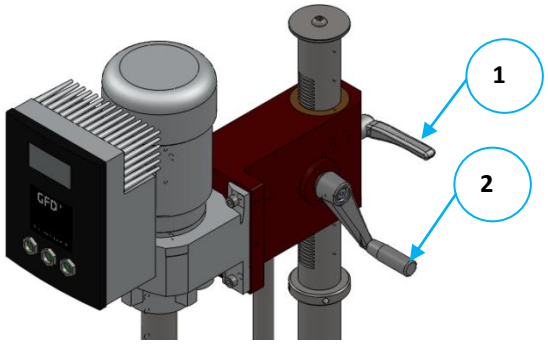
- ✓ The vessel lid must be positioned 90° off centre to the vessel base.
- ✓ Ensure upper body on the agitator seal is tightly screwed to lower body and both the upper pin (3) and lower pin (5) are inserted into the grooves to ensure the upper body, lower body and retaining ring are locked together
- ✓ Screw the agitator seal to the vessel lid with the red screw cap (8)
- ✓ Loosen the Lock nut retainer(2) and then the blue Lock nut on top of the agitator seal (1).
- ✓ Insert the agitator from the bottom of the vessel lid. Ensure the agitator blade is inside the vessel lid.
- ✓ Push agitator to required height, screw the blue lock nut (1) back and ensure it is tight. Retighten the Lock nut retainer(2).
- ✓ Lock the agitator metallic shaft end into the motor coupling.
- ✓ Rotate the vessel lid back to position above the vessel base.

6.2.4 Raising / Lowering the Agitator

WARNING: Always unscrew the cap retainer and top screw cap of the agitator seal before raising or lowering the agitator. Tight screw parts back again once the operating position is satisfactory

To raise the agitator/motor, unscrew the clamping handle (1) then turn the crank handle (2) clockwise. Once in the required position, re-tighten the clamping handle.

To lower the agitator/motor, complete the same operation as when raising but rotate the crank handle anti-clockwise to lower.



IMPORTANT NOTE: Below the mechanical housing is a location ring to set the minimum position of the agitator. PSL do not recommend removing it.

IMPORTANT NOTE: Once the vessel base has been fixed in position during the equipment set up procedure (Section 5), the Motor positional stop will prevent the agitator from coming into contact with the filter basket mesh. Changing the position of the positional stop after the set-up may lead to damage of the filter basket mesh.

6.3 OPENING THE VESSEL

6.3.1 Safety

WARNING

The Operator must ensure that where appropriate, suitable Safety Procedures are implemented to protect personnel from potential injury and the safety instructions in Section 3.0 above have been actioned.

6.3.2 Pressure Clamp

The filter basket and the two basket o-rings must be in place in the vessel base. Tighten the pressure clamp around the glass flanges so as to couple the vessel base and lid together. Precaution should be taken to not over-tighten the clamp.

6.3.3 Vessel Base

Once the GFD® has been set-up as per the instructions in Section 5.3 the Vessel Base Support Clamp will be locked in place and should not need to be adjusted again.

6.3.4 Vessel Lid

To remove the vessel lid from the base:

1. Loosen the agitator seal.
2. Raise the agitator and motor until the agitator blade is above the level of the Filter Basket. See Section 6.2.4
3. Unscrew the Chuck to uncouple the agitator from the motor.
4. Raise the motor to its highest position. So the chuck is clear of the agitator shaft end.
5. Uncouple the vessel base and the vessel lid by removing the pressure clamp
6. Follow the steps in section 5.3.2 to rotate the top of the support frame 90 degrees.

6.4 ACCESSING THE PRODUCT

6.4.1 Removing the Filter Basket

1. Remove the vessel lid from the base (Section 6.3.4)
2. Once the vessel base is cleared from the vessel lid above, remove the o-ring from the basket flange and lift out the basket.

6.4.2 Inserting the Filter Basket

Ensure the vessel lid is positioned 90° off centre to the vessel base. Always ensure the integrity of the basket, its filter mesh and the o-rings before re-inserting them into the vessel.

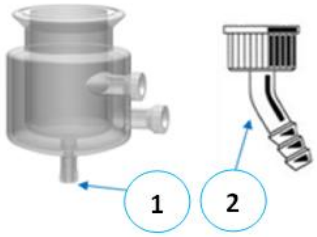
1. Insert one of the 2-off basket o-rings in the groove in the flange of the vessel base.
2. Place basket into the vessel base and ensure that the o-ring is correctly fitted with the basket in place.
3. Insert the second o-ring in the groove in the basket flange
4. Rotate vessel lid back above the vessel base and lock in place with the clamping handle.
5. Fit the pressure clamp

6.5 DRAIN CONNECTION

6.5.1 Connecting the Drain Nozzle

1: The Glass Flange profile on the bottom of the Vessel base is a GL18 thread. To connect the drain line, the operator must use an adaptor.

2: A GL18 adaptor can be purchased from any laboratory consumable supplier.



6.6 HEATING JACKET

6.6.1 Safety

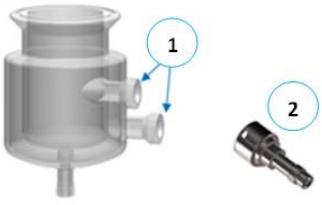
WARNING

When heating media is introduced to the **GFD®**, exposed external surfaces will become hot, it is therefore essential, that personnel likely to come into contact with these surfaces have been made aware of the conditions and wear suitable hand protection / clothing to minimise the risk of injury

6.6.2 Connecting Hoses

1: The Glass Flange connection on the Vessel Jacket is a heavy wall DN15 Flange. To connect the hoses carrying the heating/cooling fluid, the operator must use a suitable adaptor.

2: PSL offer adaptors as an option.



6.7 USING THE VESSEL NOZZLES

6.7.1 Sampling Product

During operation product samples can be obtained by removing one of the stoppers positioned on the vessel lid nozzles, however, prior to loosening a stopper, the operator MUST ensure that it is safe to do so.

6.7.2 Equipment Connections

Various different auxiliary equipment can be connected to the GFD® via the vessel lid nozzles, e.g. Temperature Probe, gauges, glassware. The correct size and style of Rodaviss connection should be used to connect any auxiliary equipment, and any equipment connected should be capable of withstanding up to 0.5bar pressure if the GFD® is to be used under pressure conditions.

For more details please refer to section 7.0 Process Operations Guide.

6.8 USING THE HIGH TORQUE BIDERCTIONAL MOTOR

6.8.1 Warnings

WARNING

DANGER

ALWAYS ENSURE THAT THE MOTOR DIRECTION KNOB IS IN THE OFF POSITION PRIOR TO CONNECTING THE CONTROL UNIT TO THE MAINS.

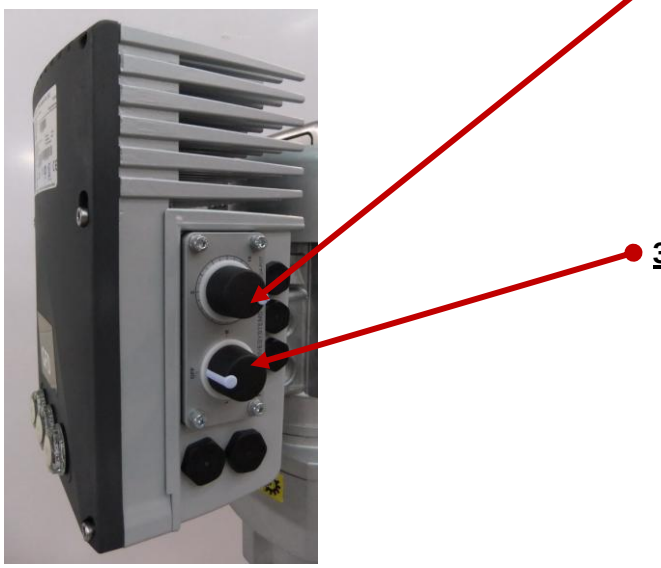
The GFD Motor can be operated by two methods, by using the invertor mounted potentiometer knobs or by using the RPM and Torque Display Parameter Box. When one method has been used the other method cannot override the settings.

6.8.2 OPERATING THE MOTOR USING INVERTOR MOUNTED POTENTIOMETER

- ✓ Turn the Motor on (clockwise or counter clockwise) with the "3-Position Selector" on the Motor Assembly and observe the rotation of the agitator shaft.

  Note: *the "3-Position Selector" must pass through the centre "off" position before the direction of rotation is changed.*

- ✓ Select the speed with the "RPM Selector" (see picture 01).



RPM Selector:

- From 5 rpm to 24 RPM.
- Use it to select the speed of rotation required

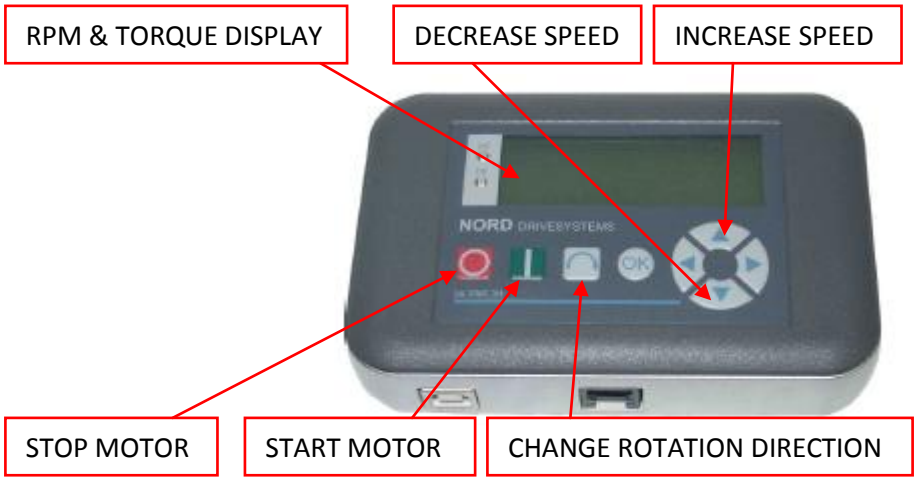
3-Position Selector:

- ***Left*** = start the motor and rotate anti-clockwise (ploughing)
- ***centre*** = "off" position, turn off the motor
- ***Right*** = start the motor and rotate clockwise (Smoothing)

TURNING OFF THE MOTOR

- ✓ Set the RPM selector on the “0” position (see picture 01)
- ✓ At the 3-positions selector switch, select “off”.

6.8.3 OPERATING THE MOTOR USING THE PARAMETER BOX



Use the buttons as labelled above to control the motor. The LCD display screen has been set to display the motor speed in RPM and the Torque current in Amps.

The LCD screen will also display the speed and torque current when the potentiometer knobs are being used to control the invertors.

More information on the control and setting of the Invertors and Parameter box can be found in the manufacturers user documentation listed below and included in annex 2.

- Nord Drive Systems Manual - BU 0040 - Control and Parameter Boxes for NORDAC Frequency Inverters
- Nord Drive Systems Manual - BU 0200 - NORDAC SK 200E Frequency inverter manual

6.8.4 Operating the High Torque Motor

- ✓ **Smoothing mode:**

To operate the agitator in smoothing mode – clockwise rotation – flick the 3-position selector to the right.

- ✓ **Ploughing mode:**

To operate the agitator in smoothing mode – anti-clockwise rotation – flick the 3-position selector to the left.

- ✓ **Speed Control**

Adjusting the RPM selector will control the speed of the agitator.

IMPORTANT NOTES:

The GFD® has been designed with a soft start speed ramp to avoid damaging the motor if started at top speed in very viscous material.
However it is still recommended that users always start the agitator at its lowest speed before slowly increasing to desired RPM**.**

6.9 RELOCATING THE EQUIPMENT

6.9.1 Safety

WARNING

The Operator must ensure that where appropriate, suitable Safety Procedures are implemented to protect personnel from potential injury and the safety instructions in Section 3.0 above have been actioned.

WARNING

DANGER

If the apparatus needs to be re-located ensure that it is disconnected from its power supply.

CAUTION

Ensure that the torque mixer, vessel lid and vessel base clamps are properly secured.

6.9.2 Moving the Equipment

The **GFD®** is a compact and very portable apparatus and can easily be re-located within a facility on its anti-static castors.

When the apparatus is in position ensure that it is stable before use.

7.0 PROCESS OPERATIONS GUIDE

The objective of this Chapter of the User's Manual is to explain how basic key operations could be performed on the GFD®.

With more than 22 year of experience in filtration and drying equipments PSL can affirm there are as many ways to utilise the GFD® as there are products to process in the equipment. Therefore we can only highlight the major steps to filtration and drying, which are to be adjusted in function of your requirements:

(7.1) Charging the Product (7.2) Washing/filtering (7.3) Drying (7.4) Taking Samples (7.5) Recovering the product

Along the process development samples can be taken to ensure operations run according to the user's requirement.

7.1 CHARGING THE PRODUCT

Information

Ensure you have the appropriate connections as PSL do not provide them.

STEP 1 Connect the user's reactor to one of the GFD® vessel lid nozzle.

STEP 2: To pour/transfer the reactor's content (a.k.a. slurry) apply vacuum in the GFD®.

NOTE 1*: Depending on your requirements, vacuum can be applied from either the top (vessel lid nozzle) or the bottom of the GFD® (vessel base drain*).

NOTE 2*: Other slurry transfer methods can be used depending on your requirements.*

7.2 WASHING / FILTERING THE CAKE

Washing the cake is an important step of filtration and drying as it removes all impurities from the slurry. According to your requirements you might want to collect either the solid or the filtrate.

There are mainly two cake wash methods: (1) re-slurry wash and (2) displacement wash. The choice depends on your process requirements.

Generally 3 washing cycles would be performed in the GFD®.

Once the slurry is poured into the GFD®, with the filter basket in place, the following steps can be applied to the cake:

Step 1 Smoothing the cake. (Purpose: enhances drying of the cake)

- ✓ Place the agitator on the top of the cake and rotate clockwise ensuring cake is smooth with no cracks
- ✓ In the meantime, apply either pressure up to ½ barg, vacuum up to -1 barg or both.

Note 1: *if both pressure and vacuum are applied to their maximum allowed in the GFD® the pressure differential across the cake will be 1.5 barg.*

Note 2: *The vessel jacket can be filled with warm liquid to keep the slurry mobile.*

WARNING

DANGER

Never exceed ½ barg pressure

Step 2 Charging the solvent .

- ✓ Charge washing solvent into the GFD®.

Note: *The solvent inlet can be either connected to one of the vessel lid nozzle, come from the slurry or come from the slurry inlet that is fitted upstream with a valve to let solvent in.*

Step 3: Wash the cake. (Purpose: removes impurities from the cake)

- ✓ Adjust the agitator height in the cake in function of your requirements.
- ✓ Rotate anti-clockwise to plough.

Step 4 Re-filtering.

- ✓ To proceed please start from Step 1 again.

Step 5: Final Filtration.

- ✓ Repeat step 1 to 4 as many times as required in your process until final filtration is completed.

7.3 DRYING THE CAKE

This step is the last one before product recovery.
Generally, at this stage the user will require to apply both vacuum and heating.

Step 1 Apply Vacuum.

- ✓ Vacuum from the bottom only can be required for low density cakes.
- ✓ A vacuum line connected at both the top (vessel lid) and the bottom (vessel base) can be required for higher density cakes.

CAUTION

NEVER APPLY VACUUM FROM THE TOP (VESSEL LID) ONLY.

Step 2 Nitrogen (N_2).

Connect a N_2 inlet to one of the vessel lid nozzle and apply N_2. The gas will travel through the cake thus improving the drying performances.

7.4 TAKING SAMPLES

During the operation samples can be taken to ensure your process runs according to your requirements or to study the cake before the process is terminated.

WARNING

PRIOR TO START THIS OPERATION, ENSURE THE GFD® IS AT ATMOSPHERIC PRESSURE

WARNING

PRIOR TO START THIS OPERATION; ENSURE THE GFD® IS NOT RUNNING.

Step 1 Ensure agitator is not running.

- ✓ Turn off the motor at the control box.

Step 2 Ensure vacuum is not running.

- ✓ Stop the vacuum inlet.

Step 3 Ensure vessel is at atmospheric pressure or room pressure.

- ✓ Stop pressure inlet.
- ✓ Stop Nitrogen inlet.

Step 4 Remove a stopper on the vessel lid.

Note: *If there is no available nozzle we recommend to the user to not remove possible instruments but to remove the easiest and safest inlet such as the nitrogen inlet or the solvent inlet.*

7.5 RECOVERING THE PRODUCT

Thanks to its unique removable filter basket the GFD® guarantees full product recovery.

WARNING

ISOLATE ALL SERVICES PRIOR TO THE START OF ANY WORK.

WARNING

PRIOR TO START THIS OPERATION; ENSURE THE GFD® IS NOT RUNNING.

Step 1: Ensure agitator is not running.

- ✓ Turn off the motor at the control box.

Step 2: Ensure vacuum is not running.

- ✓ Stop the vacuum inlet.

Step 3: Ensure vessel is at atmospheric pressure or room pressure.

- ✓ Stop pressure inlet.
- ✓ Stop Nitrogen inlet.

Step 4: Loosen the agitator seal.

- ✓ Unscrew the agitator seal to free the agitator.

Step 5: Ensure agitator is a maximum height.

- ✓ The agitator blade must be fully inside the vessel lid and therefore cleared from the vessel base.

Step 6: Uncouple the vessel base and lid.

- ✓ Remove the red pressure clamp around the vessel flanges.

Step 7: Swing the vessel lid out.

- ✓ Loosen the vessel lid support clamp at the pole.
- ✓ Rotate the drive assembly and vessel lid so as to clear the vessel base.

Step 8: Lift the basket.

- ✓ You can now take the basket out of the GFD®.

8.0 MAINTENANCE OPERATIONS

Prior to the commencement of operation it is necessary to observe the following procedures and instructions. Should any fault be detected and replacements required, then refer to the relevant section of these maintenance procedures.

8.1 ABOUT THESE PROCEDURES

There are two sections to the maintenance procedures:

- PSL Maintenance Procedures: Where the equipment is wholly supplied by Powder Systems Limited.
- Procured Items Data: Where equipment is supplied by other manufacturers.

It is deemed more suitable to keep other manufacturers maintenance procedures in the format in which they are supplied. Hence any components which are not listed within the PSL maintenance procedures will be supplied separately as part of your documentation pack.

Whilst every care is taken to ensure that the information in this manual is correct, no liability can be accepted for damage or injury caused by any errors in, or omissions from, the information given.

8.2 GENERAL MAINTENANCE PROCEDURES

WARNING

ISOLATE ALL SERVICES PRIOR TO THE START OF ANY WORK.

WARNING

ENSURE THAT THE INTERNAL PRESSURE OF THE FILTER IS EQUAL TO ATMOSPHERIC PRESSURE (0 BARG), THE VESSEL HAS BEEN FULLY DRAINED AND CLEANED THOROUGHLY OF ANY POTENTIALLY HAZARDOUS SUBSTANCES PRIOR TO THE COMMENCEMENT OF ANY MAINTENANCE ACTIVITY.

These maintenance procedures / instructions are provided to help the user identify parts that from time to time should be inspected and where necessary replaced to ensure the continued satisfactory operation of the apparatus.

Within this section you will find that some procedures / instructions that have been covered elsewhere in this manual, however, they are repeated here because it is important that they are understood and adhered to both for safety and operational reasons.

8.2.1 Joints, Mating Faces & O-rings

Where an o-ring is used between mating faces of two components ensure that it is not suffering from deterioration, chemical attack, wear, or leakage. If a gasket requires replacement make sure that the mating faces are clean and dry with all traces of old o-rings removed.

When cleaning a joint face, use a tool which is not likely to score or damage the face, and remove any burrs or nicks that may be present. Make sure any tapped holes are cleaned and any orifices, channels or pipes are thoroughly cleaned.

8.2.2 Screw Threads & Fastenings

Always ensure that a blind tapped hole is completely free from fluids and other incompressible media before installing the fixing. When checking or re-tightening a nut or bolt to a specified torque setting, slacken the nut or bolt by a quarter of a turn, and then re-tighten to the specified torque.

8.2.3 Lock Tabs & Washers

Any fastening, which, will rotate against a component or housing in the course of tightening, should always have a washer between it and the relevant component or housing. Lock tabs, which, are folded over to retain a nut or bolt, should always be renewed. Locknuts with integral locking devices are used also; these locknuts have a setscrew perpendicular to the main thread that must be loosened before locknut removal.

8.2.4 Bearings

Unless otherwise stated the bearings used on this equipment have integral seals or. The standard greases within these bearings have operating temperature ranges and other properties to suit the intended application areas. The service life of the grease exceeds bearing life so that, no provision is made for re-lubrication.

Any additional maintenance requirements for specific bearings shall be described in their relevant sections.

8.2.5 Flexible Pipework Etc.

Where a flexible pipe or joint is used between two components ensure that it is not suffering from deterioration, chemical attack, damage, wear or leakage. Should replacement be required then refer to the relevant section of these procedures.

8.3 RECOMMENDED MAINTENANCE INTERVALS

TIME	DESCRIPTION
DAILY	Check for general running, excessive noise and the operation of the system.
WEEKLY	Check o-rings and seals etc. for leaks or signs of wear.
MONTHLY	Check and remove any dust build up on components.

8.4 ITEM SPECIFIC MAINTENANCE

8.4.1 O-rings

In respect of "O" ring seals, they should be routinely inspected for leakage and any obvious signs of deterioration or accidental damage.

If it is necessary to replace seals, it is important that mating surfaces, ie: - "O" ring grooves are not damaged in the process. Although unlikely to occur, if a seal is stuck in place and a tool is required to assist removal, it is important to select the right tool so as to prevent damage to the groove surface. Once the seal is removed, the mating surfaces should be examined to ensure they are free of any debris in preparation for the replacement components.

PLEASE NOTE: To ensure continuity of operations, it is highly recommended that spare seals are held in stock

8.4.2 Filter Baskets

Filter Basket should be routinely inspected for any obvious signs of deterioration or accidental damage to the sealing faces and o-ring groove or to the filter mesh. If any signs of damage are present, PSL recommend that the basket be replaced to ensure correct functionality of the GFD®.

PLEASE NOTE: To ensure continuity of operations, it is highly recommended that spare baskets are held in stock

8.4.5 Support Stand and Vessel Clamps

Before every use of the GFD® all support frame, vessel clamps and positional stop screws should be checked for tightness to prevent damage to the equipment.

8.4.6 Glass Vessel and Stoppers

All glass components should inspected before every use for any obvious signs of deterioration or accidental damage. If any damage is found, components should **immediately** be replaced to prevent possible injury.

8.4.7 Agitator raise / lower mechanism

To ensure that the mechanism continues to run smoothly, it is recommended that it is inspected six monthly for excessive movement when locked in position, indicating wear & tear.

The mechanism internal parts and rack teeth have been coated with an FDA compliant lubricant to aide smooth movement. Should re-lubrication be necessary, use a suitable FDA compliant lubricant for moving metallic parts. For example: Ambersil MP Food Grease FG Aerosol.

9.0 PSL QUALITY CERTIFICATES

Powder Systems Limited

EC Machinery Directive 2006/42/EC
CE- Declaration of Conformity

Machine or Machine Parts Description:
PF-00003-115 – MAXI GFD 115V

NOTE: Modifications to the machine without written approval from the undersigned will render this declaration null and void.

Name and Address of Manufacturer:
Powder Systems Limited Estuary Business Park Liverpool, L24 8RG United Kingdom

We hereby certify that the equipment stipulated above complies with the relevant provisions of the EC Machinery Directive and the National Laws and Regulations adopting this directive.

Is in conformity with the provisions of the following other EEC Directives:
Machinery Directive 2006/42/EC
Low Voltage Directive 2006/95/EC

Harmonised / National Technical Standards and Specifications were applicable:
BS EN ISO 12100-2-2003+Amendment 1:2009 Safety of Machinery. Basic Concepts, General Principles for Design Technical Principles
BS EN ISO9001: 2008 Quality Management Systems - Requirements
HSE Statutory Instrument No 2306, The Provision & Use of Work Equipment Regulations: 1998

Powder Systems Limited

Certificate of Conformance

CONTRACT / SERIAL NUMBER

PSL Part Reference

PF-00003-115 - MAXI GFD 115V

TO WHOM IT MAY CONCERN,

"We certify that the items referenced above and supplied against your Purchase Order have satisfied the inspection/verification requirements of our ISO9001:2008 Quality Assurance Management System and conform to your requirements"

Name (Print):	Signature:	Position

10.0 ANNEX 1

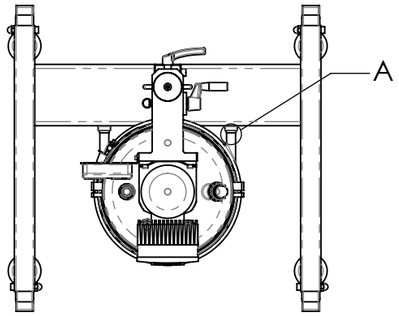
Please see next page.

IF IN DOUBT, ASK!

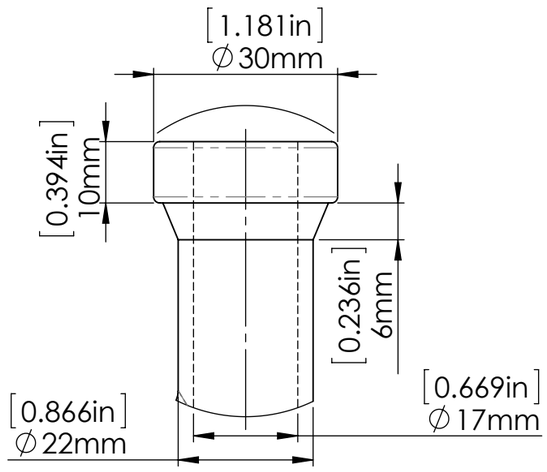
ELECTRICAL DATA		
PRODUCT CODE	VOLTAGE	PLUG CONNECTION
PF-00003-230	230V - 50 Hz	UK- Type G, BS 1363 – (13A/230-240V 50Hz grounded and fused) Europe – Type E/F Hybrid CEE 7/7 (16A/250V grounded)
PF-00003-115	115V - 60 Hz	US – NEMA 5-15 (15A/125V grounded) Japan – JIS C 8303, Class I (15A/100V grounded)

NOZZLE SCHEDULE		
NO	SIZE	ORIENTATION
N1	24/29 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	VERTICAL
N2	24/29 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	ANGLED
N3	19/26 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	VERTICAL
N4	29/32 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	ANGLED
N5	45/40 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	VERTICAL
N6	B34 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	VERTICAL
N7	SEE DETAIL (HEAVY WALL DN 15 GLASS FLANGE)	HORIZONTAL
N8	SEE DETAIL (HEAVY WALL DN 15 GLASS FLANGE)	HORIZONTAL
N9	GL25 SCREW THREAD	VERTICAL

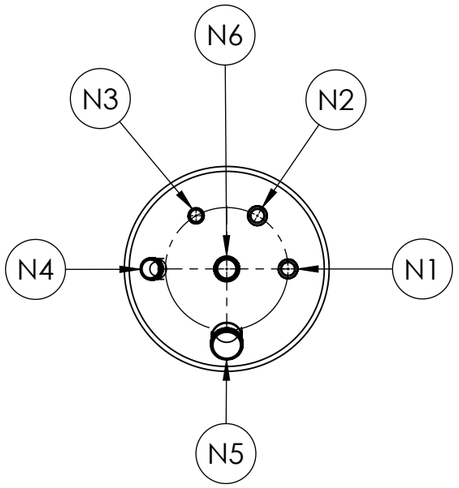
DESIGN DATA			
Filtration area	0.05m²		
Cake volume	5 Litre		
Cake depth (max)	100mm		
Volume	10 Litres		
	Vessel	Jacket	Unit
Design Temperature (Min)	-25(-13)	-25(-13)	°C(°F)
Design Temperature (Max)	150(302)	150(302)	°C(°F)
Design Pressure (Min)	FV	FV	barg (psig)
Design Pressure (Max)	0.5 (7.25)	0.5 (7.25)	barg (psig)
Area Classification Internal /External	Safe Area		
OEL	The PSL GFD is not classified as containment equipment and therefore has to be used in conjunction with other equipment suitable to protect operator from exposure to potent compounds.		



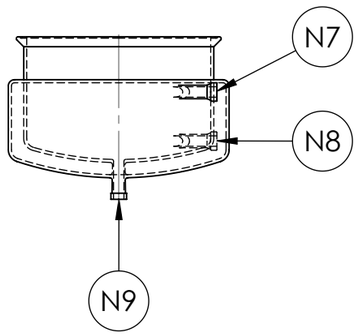
PLAN



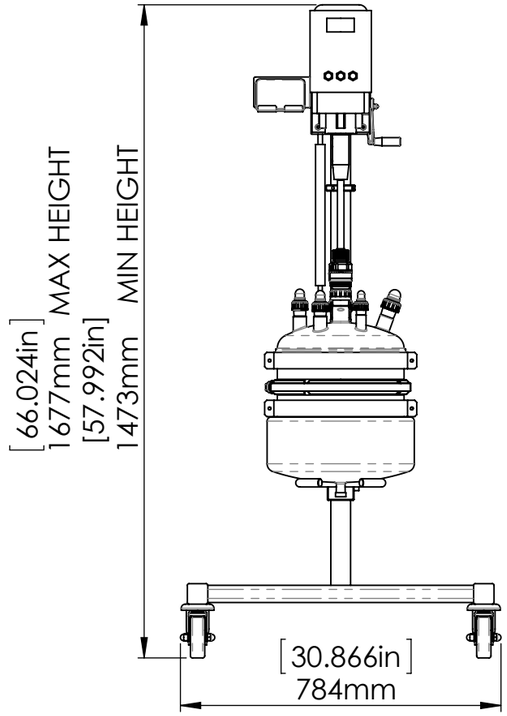
DETAIL A
N7 & N8 NOZZLE SIZE



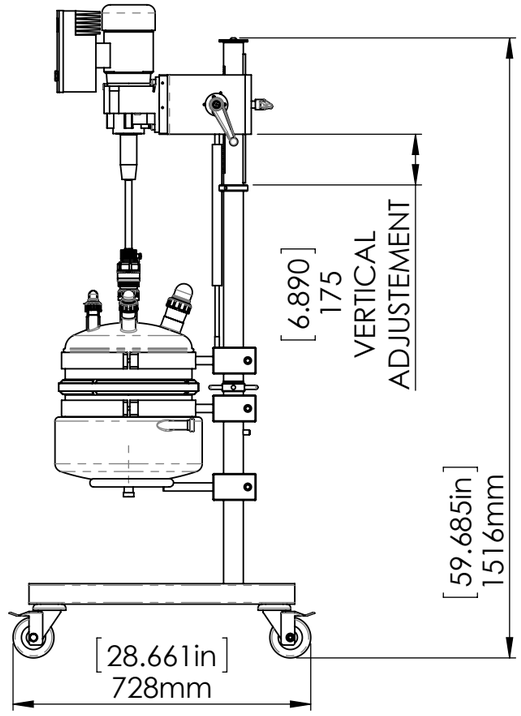
VESSEL LID



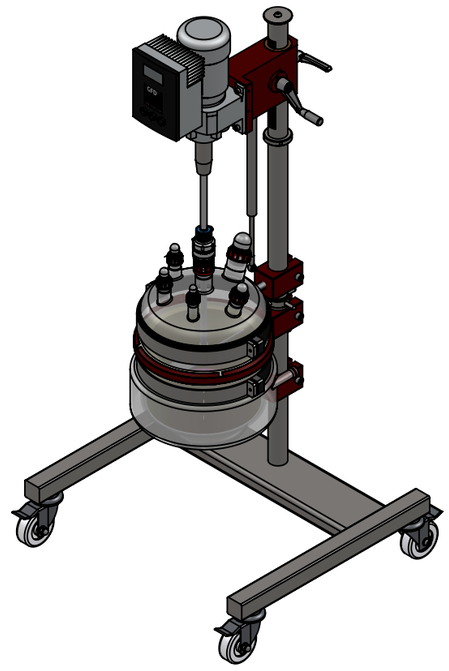
VESSEL BASE



FRONT ELEVATION



SIDE ELEVATION



REVISION F	REVISION E	REVISION D	REVISION C	REVISION B	REVISION A
–	–	–	–	– PRODUCT CODE UPADTE	–ORIGINAL ISSUE
MOD BY: INITS	MOD BY: INITS	MOD BY: INITS	MOD BY: INITS	MOD BY: AGM	MOD BY: AGM
APPROVED: INITS	APPROVED: INITS	APPROVED: INITS	APPROVED: INITS	APPROVED: -	APPROVED: -
DATE: --/--/--	DATE: --/--/--	DATE: --/--/--	DATE: --/--/--	DATE: 05/12/11	DATE: 09/09/2011
CUSTOMER APPROVAL DATE: --/--/--	CUSTOMER APPROVAL DATE: --/--/--	CUSTOMER APPROVAL DATE: --/--/--	CUSTOMER APPROVAL DATE: --/--/--	CUSTOMER APPROVAL DATE: --/--/--	CUSTOMER APPROVAL DATE: --/--/--

DIMENSIONS IN mm
DO NOT SCALE

REMOVE ALL BURRS AND SHARP EDGES.

WELDING IS TO BE CONTINUOUS FILLET, FREE FROM CRACKS, & CREVICES AND FINALLY GROUND TO BLEND INTO SURROUND MATERIAL UNLESS OTHERWISE STATED

POWDER SYSTEMS LTD
ESTUARY BUSINESS PARK
LIVERPOOL L24 8RG
UNITED KINGDOM
www.powdersystems.com

THIRD ANGLE PROJECTION

DRN BY	AGM
DATE	09/09/2011
SCALE	NTS
CHK BY	CMP
APPR BY	CMP

SHEET 1 OF 1

PSL USE ONLY: SW

TITLE: MAXI GFD

DRG NO. PF-00003-B01

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